

Claims

1. An optical amplifier module containing at least one optical amplifier, said module comprising:

an internal housing having an outer dimension substantially equal to an outer dimension of an internal fiber splice housing of an undersea optical fiber cable joint, said internal housing including:

a pair of opposing end faces each having a retaining element for retaining the internal housing within an outer housing of said undersea optical fiber cable joint;

a sidewall interconnecting said opposing end faces and extending between said opposing end faces in a longitudinal direction, said sidewall including a receptacle portion having a plurality of thru-holes each being sized to receive a passive optical component employed in an optical amplifier;

at least one circuit board on which reside electronics associated with the optical amplifier; and

an isolated electrical path for providing electrical power received from a conductor in at least one optical fiber cable to the at least one circuit board.

2. The optical amplifier module of claim 1 wherein said undersea optical fiber cable joint includes a pair of cable termination units in which end portions of optical fiber cables to be jointed are respectively retained, said retaining elements each being connectable to one of the cable termination units.

3. The optical amplifier module of claim 2 wherein said conductor of each of the optical fiber cables to be jointed are in electrical contact with one of the retaining elements.

4. The optical amplifier module of claim 3 wherein said isolated electrical path includes a power conductor located within the circuit board that is in electrical contact with one of the retaining elements.
5. The optical amplifier module of claim 4 further comprising at least one voltage dropping element for conveying a portion of voltage from the power conductor to the electronics associated with the optical amplifier.
6. The optical amplifier module of claim 5 wherein said voltage dropping element is a zener diode.
7. The optical amplifier module of claim 4 wherein said at least one circuit board comprises a pair of circuit boards, and wherein said isolated electrical path further comprises at least one electrically conductive pin electrically connecting the power conductors of the pair of circuit boards.
8. The optical amplifier module of claim 1 wherein said plurality of thru-holes laterally extend through said receptacle portion of the sidewall in the longitudinal direction.
9. The optical amplifier module of claim 1 wherein said internal housing has a generally cylindrical shape, said receptacle portion of the sidewall having a curvature that defines a diameter of the cylindrical shape.
10. The optical amplifier module of claim 1 wherein the undersea optical fiber cable joint is a universal joint for jointing optical cables having different configurations.
11. The optical amplifier module of claim 1 wherein said retaining elements each include a flange through which at least one optical fiber extending from the end portion of one of the optical cables extends into the internal housing.

12. The optical amplifier module of claim 1 further comprising an optical fiber storage area located within said internal housing.
13. The optical amplifier module of claim 12 wherein said optical fiber storage area includes at least one optical fiber spool around which optical fiber can be wound.
14. The optical amplifier module of claim 1 wherein said internal housing is formed from a pair of half units that each include one of the retaining elements.
15. The optical amplifier module of claim 7 wherein said internal housing is formed from a pair of half units that each include one of the retaining elements.
16. The optical amplifier module of claim 15 wherein each circuit board is located in a different one of the half units.
17. The optical amplifier module of claim 1 wherein said sidewall includes a pair of ribbed members extending longitudinally from the receptacle portion of the sidewall, said ribbed members each having a tension rod thru-hole extending laterally therethrough in the longitudinal direction for supporting a tension rod employed by the undersea optical fiber cable joint.
18. The optical amplifier module of claim 1 wherein the outer dimension of the internal housing is less than about 15 cm x 50 cm.
19. The optical amplifier module of claim 1 wherein the outer dimension of the internal housing is about 7.5 cm x 15 cm.
20. In an external, hermetically sealed outer housing of an undersea optical fiber cable joint, an optical amplifier module comprising:
 - a protective sleeve;

an internal housing located in said protective sleeve, said internal housing including:

a pair of opposing end faces each having a retaining element for retaining the internal housing within an outer housing of said undersea optical fiber cable joint; and

a sidewall interconnecting said opposing end faces and extending between said opposing end faces in a longitudinal direction, said sidewall including a receptacle portion having a plurality of thru-holes each being sized to receive a passive optical component employed in an optical amplifier;

at least one circuit board on which reside electronics associated with the optical amplifier; and

an isolated electrical path for providing electrical power received from a conductor in at least one optical fiber cable to the at least one circuit board.

21. The optical amplifier module of claim 20 wherein said undersea optical fiber cable joint includes a pair of cable termination units in which end portions of optical fiber cables to be jointed are respectively retained, said retaining elements each being connectable to one of the cable termination units.

22. The optical amplifier module of claim 21 wherein said conductor of each of the optical fiber cables to be jointed are in electrical contact with one of the retaining elements.

23. The optical amplifier module of claim 22 wherein said isolated electrical path includes a power conductor located within the circuit board that is in electrical contact with one of the retaining elements.

24. The optical amplifier module of claim 23 further comprising at least one voltage dropping element for conveying a portion of voltage from the power conductor to the electronics associated with the optical amplifier.

25. The optical amplifier module of claim 24 wherein said voltage dropping element is a zener diode.

26. The optical amplifier module of claim 23 wherein said at least one circuit board comprises a pair of circuit boards, and wherein said isolated electrical path further comprises at least one electrically conductive pin electrically connecting the power conductors of the pair of circuit boards.

27. The optical amplifier module of claim 20 wherein said plurality of thru-holes laterally extend through said receptacle portion of the sidewall in the longitudinal direction.

28. The optical amplifier module of claim 20 wherein said internal housing has a generally cylindrical shape, said receptacle portion of the sidewall having a curvature that defines a diameter of the cylindrical shape.

29. The optical amplifier module of claim 20 wherein the undersea optical fiber cable joint is a universal joint for jointing optical cables having different configurations.

30. The optical amplifier module of claim 29 wherein said universal joint includes a pair of cable termination units in which end portion of the optical cables to be jointed are respectively retained, said retaining elements each being connectable to one of the cable termination units.

31. The optical amplifier module of claim 30 wherein said retaining elements each include a flange through which at least one optical fiber extending from the end portion of one of the optical cables extends into the internal housing.

32. The optical amplifier module of claim 20 further comprising an optical fiber storage area located within said internal housing.

33. The optical amplifier module of claim 30 wherein said optical fiber storage area includes at least one optical fiber spool around which optical fiber can be wound.
34. The optical amplifier module of claim 20 wherein said internal housing is formed from a pair of half units each including at least one of the retaining elements.
35. The optical amplifier module of claim 26 wherein said internal housing is formed from a pair of half units each including at least one of the retaining elements.
36. The optical amplifier module of claim 35 wherein each circuit board is located in a different one of the half units.
37. The optical amplifier module of claim 20 wherein said sidewall includes a pair of ribbed members extending longitudinally from the receptacle portion of the sidewall, said ribbed members each having a tension rod thru-hole extending laterally therethrough in the longitudinal direction for supporting a tension rod employed by the undersea optical fiber cable joint.
38. The optical amplifier module of claim 20 wherein the outer dimension of the internal housing is less than about 15 cm x 50 cm.
39. The optical amplifier module of claim 20 wherein the outer dimension of the internal housing is about 7.5 cm x 15 cm.
40. An undersea optical repeater, comprising:
an external, hermetically sealed outer housing of an undersea optical fiber cable joint, an optical amplifier module comprising:
a protective sleeve located in said outer housing;

an internal housing located in said protective sleeve, said internal housing including:

a pair of opposing end faces each having a retaining element for retaining the internal housing within an outer housing of said undersea optical fiber cable joint; and

a sidewall interconnecting said opposing end faces and extending between said opposing end faces in a longitudinal direction, said sidewall including a receptacle portion having a plurality of thru-holes each being sized to receive a passive optical component employed in an optical amplifier;

at least one circuit board on which reside electronics associated with the optical amplifier; and

an isolated electrical path for providing electrical power received from a conductor in a pair of optical fiber cables to the at least one circuit board.

41. The undersea optical repeater of claim 40 further comprising a pair of cable termination units in which end portions of the optical fiber cables to be jointed are respectively retained, said retaining elements each being connected to one of the cable termination units.

42. The undersea optical repeater of claim 40 wherein said conductor of each of the optical fiber cables to be jointed are in electrical contact with one of the retaining elements.

43. The undersea optical repeater of claim 41 wherein said conductor of each of the optical fiber cables to be jointed are in electrical contact with one of the retaining elements.

44. The undersea optical repeater of claim 42 wherein said isolated electrical path includes a power conductor located within the circuit board that is in electrical contact with one of the retaining elements.

45. The undersea optical repeater of claim 44 further comprising at least one voltage dropping element for conveying a portion of voltage from the power conductor to the electronics associated with the optical amplifier.

46. The undersea optical repeater of claim 45 wherein said voltage dropping element is a zener diode.

47. The undersea optical repeater of claim 40 wherein said at least one circuit board comprises a pair of circuit boards, and wherein said electrical path further comprises at least one electrically conductive pin electrically connecting the power conductors of the pair of circuit boards.

48. The undersea optical repeater of claim 40 wherein said plurality of thru-holes laterally extend through said receptacle portion of the sidewall in the longitudinal direction.

49. The undersea optical repeater of claim 40 wherein said internal housing has a generally cylindrical shape, said receptacle portion of the sidewall having a curvature that defines a diameter of the cylindrical shape.

50. The undersea optical repeater of claim 40 wherein the undersea optical fiber cable joint is a universal joint for jointing optical cables having different configurations.

51. The undersea optical repeater of claim 40 wherein said retaining elements each include a flange through which at least one optical fiber extending from the end portion of one of the optical fiber cables extends into the internal housing.

52. The undersea optical repeater of claim 40 further comprising an optical fiber storage area located within said internal housing.

53. The undersea optical repeater of claim 52 wherein said optical fiber storage area includes at least one optical fiber spool around which optical fiber can be wound.

54. The undersea optical repeater of claim 40 wherein said sidewall includes a pair of ribbed members extending longitudinally from the receptacle portion of the sidewall, said ribbed members each having a tension rod thru-hole extending laterally therethrough in the longitudinal direction and further comprising a tension rod extending through one of the tension rod thru-holes and each of the end faces.

55. The undersea optical repeater of claim 54 wherein the tension rods are each electrically isolated from at least one of the end faces.

56. The undersea optical repeater of claim 40 wherein the outer dimension of the internal housing is less than about 15 cm x 50 cm.

57. The undersea optical repeater of claim 40 wherein the outer dimension of the internal housing is about 7.5 cm x 15 cm.